MANIPULATIONS

IN THE

SCIENTIFIC ARTS.

PART IV.

PHOTOGENIC MANIPULATION.

PHOTOGENIC MANIPULATION:

PART II.

79

CONTAINING

THE THEORY AND PLAIN INSTRUCTIONS

IN THE ART OF

PHOTOGRAPHY,

OR

THE PRODUCTION OF PICTURES THROUGH THE AGENCY OF LIGHT.

DAGUERREOTYPE.

BY

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PHOTOGENIC MANIPULATION.

PART II.

DAGUERREOTYPE.

1. In the first part of *Photogenic Manipulation*, we have described a variety of processes by which impressions can be obtained upon paper, glass, &c. by the action of light. This second portion of our Manual, it is our intention to devote entirely to the method of producing pictures upon silver plates, a beautiful art, well known throughout Europe as the "Daguerreotype." (1.) (7.) Part I.

2. This art has been patented in England, although the discoverers, Daguerre and Niepce, had a handsome pension allotted to them on condition that the process should be given "freely to the whole world."

3. The manipulation requisite to obtain a perfect picture by this process appears at first to offer more difficulties to a beginner than most of the other photographic processes; but, in reality, this is not the case, for, with care and attention to the details subsequently given, very little difficulty will be found.

4. The entire process may be divided into six distinct operations:—

1st. Cleaning and polishing the silver surface of the plate.

2nd. Applying the iodine and other sensitive coatings.

3rd. Obtaining the impression on the plate by means of the camera.

4th. Rendering the impression so obtained visible by the aid of mercury.

5th. Removing the sensitive coating of iodine and bromine.

6th. Fixing the picture by means of a coating of gold, and drying the plate.

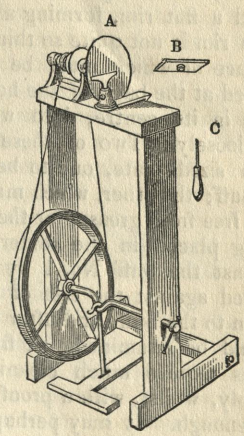
5. These processes we shall now proceed to describe at length, after devoting a little space to some remarks on the choice of the plates. Of these, several varieties are sold; those of English manufacture are perhaps the best adapted for a beginner, being stouter than the French or German, and the surface of silver being thicker, they will allow of being more frequently cleaned.

6. The silver, however, on the English plate, is not so pure as on the French. The former generally contains a quantity of lead, which is, to a certain extent, detrimental. The French plates should not be inferior to those marked 1.40, and there are some marked 1.20 that are still better, and, though more expensive, they are perhaps in the end less costly. No one should use plates less than 1.40 without being sure of obtaining a satisfactory daguerreotype the first trial, for they will scarcely admit of being repolished, especially if the picture has been fixed with the hyposulphite of gold. Good plates should have no specks or scratches on the surface, and if any trace of copper be observed on the silver surface, the plate should be rejected.

7. We shall now proceed to describe the first process, viz., cleaning and polishing the silvered surface of the plate. For this innumerable plans have been proposed; almost every operator, after a time, adopting some method of his own. At many of the daguerreo-

type establishments, the plates are cleaned in a lathe. Fig. 13 represents one suited for this purpose. A is a circular piece of wood about 7 inches diameter, covered with thick cotton velvet, and termed a buff; there should be two of these; by means of the foot they can be revolved very rapidly. The first, or cleaning buff, is charged by being moistened with olive oil, and then powdered over with French tripoli, or very fine rotten-stone. It is best applied by putting some into a muslin bag, and striking the buff with it. The second, or polishing buff, is dusted over in the same manner, with a mixture of equal parts of prepared charcoal and the best rouge. Great care should be taken to keep this buff perfectly clean, and, especially, free from grease.

Fig. 13.



8. Some have recommended—that the cotton-velvet on this buff should be previously soaked in a strong solution of soda, in order more effectually to get rid of any greasy matter. It should then be nailed on the circular board, without any part of its surface being touched by the fingers. Ammonia has been recommended instead of soda, but the latter is decidedly the better of the two; for, if there be any grease in the velvet, the ammonia will form a soap with it, more injurious to the plate than the grease itself. Our plan is, to nail on and use the velvet in the state it is sold, and by using plenty of charcoal and rouge, after polishing a few plates, the velvet becomes quite clean.

A method of holding the plate against the revolving buff is now required; for this purpose, the plate-holder B, Figs. 13 and 18, is used. It consists of a square plate of iron, rather larger than the silver plate, round which is fixed a flat rim, forming a space the size of the latter. This rim is not quite so thick as the plate, the silvered surface of which must be above it. A brass boss is placed at the back of the holder, having a cup-shaped hole in its centre, into which the steel spindle C fits loosely. Two of these holders are required for each sized plate, one to be used with the No. 1, or oil buff; the other, which must be kept perfectly clean, and free from grease, for the finishing buff. The plate being placed in the holder, the latter is held firmly against the buff No. 1 by the spindle, which is also placed against the rest of the lathe. Motion is now given to the buff, and after a few revolutions the plate should be examined. A fixed impression will sometimes require much cleaning, particularly if gilded deeply, whilst, with a proof not fixed, a few turns will be enough. It may perhaps be difficult to conceive, without seeing the apparatus at work, how the plate can be cleaned with a revolving plate-holder, the buff also revolving; but the reader must recollect that the plate-holder is not held in the centre of the buff, or in other words, the centre of the plate-holder and the centre of the lathe do not coincide—for, if so, the plate would obviously not be cleaned—but if the two centres are a very little removed from each other, then the plate and buff revolve in opposite directions, and thus the plate is very perfectly and evenly cleaned and polished, for every instant the buff cuts the plate in a different direction.

9. We will now suppose the operator has laid bare an even surface of silver: the next step is to get rid of all the oil. The greater part may be removed by means of cotton wool. The plate should then be laid, face downwards, upon a piece of cotton velvet, and rubbed backwards and forwards until an *apparently* clean and

pure surface is obtained. This, however, is not the case; for the surface is still *chemically* greasy. The plate now requires what is technically called burning; that is, decomposing the remaining oil by heat.* For this purpose the operator will require a spirit-lamp and a pair of plyers or the stand used also for the fixing process, fig. 41. The plate should be held by one corner with the plyers, and the flame of the spirit-lamp applied to the under surface, until white spots or clouds appear on the previously bright surface; the lamp should then be withdrawn, and the plate suffered to cool. This process requires a little care; for if the plate be not heated enough, white clouds will form in an after process, viz., whilst gilding. This is an extremely annoying circumstance, as we seldom attempt to gild any except really good pictures.

10. If the plate be heated too much, it will be almost impossible afterwards to obtain that fine black polish which is so essential to a good daguerreotype, the shadows will appear full of innumerable minute white spots, giving a grey appearance to the whole picture. Especial care should be taken when manipulating with French plates, as, on account of their being so much thinner, they bear but a slight heat, and, if overdone, are liable to become soft and bend; the texture of the silver is also altered by too much heat. It is safer, and perhaps a better plan to clean these with spirit alone, and not attempt to use any oil, they will not then require burning; more time, however, will be required in cleaning them. After the plate has been burnt and suffered to cool, it is applied to the finishing buff, all possible precaution being taken to keep it free from grease. When a number of plates are to be done, it is best to oil, buff, and burn them all, before commencing the

* We believe M. Claudet does not burn the oil out of his plates, but contents himself with simply rubbing the plate on a large piece of clean cotton velvet, having no powder of any sort upon it. This plan appears to do very well for his method of preparing the plates with the weak bromide of iodine, but it does not answer if the bromide of lime be used.

polishing process on the second buff. Plenty of the prepared charcoal should be used, and the plate applied to the buff until a fine polish is obtained; the pressure should be moderately strong at first and then gradually lessened; the plate should be finished by a quick revolution and a very light pressure with the plate holder; the plate should be taken away from the buff during its revolution, and it will then be quite ready for the next or iodizing process, but in inexperienced hands this is rather a difficult thing to do, particularly with large plates, for they are apt to fly out of the holder and be damaged by falling. If it can be accomplished, the plate will present a fine black polish, with scarcely any *visible marks of the velvet*, whilst if the lathe is *stopped*, and the plate *then taken* off, it will have a circular *grain* on its surface, indicating the direction of the last revolution of the buff; the plate should either have no visible *grain*, or it should have one in a direction across the narrow part of the plate if intended for a portrait, or, if for a view, the lengthway, that is in the same direction as the horizontal lines of the picture.

11. To "*lay the grain*" of the plate, daguerreotypists use a straight buff, represented by fig. 14. It consists of a piece of wood covered with clean cotton velvet, and slightly curved so as to allow for the deviation from the parallel direction which the motion of the hand invariably takes in the operation of buffing; the plate should be placed in the holder, Fig. 18, and lightly buffed in the direction required, having previously dusted a little of the charcoal powder on the buff; the cleaning and polishing process has now been finished, and we may at once proceed to iodize the plate. We have described at some length the method of cleaning and polishing with the lathe, because, by its

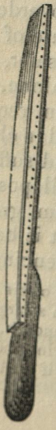


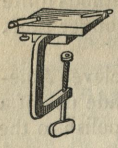
Fig. 14.

means, plates may be more quickly prepared than by any other plan; however, there are other methods quite as effectual, although they occupy a little longer time, still they are preferred by some.

Messrs. Paine of Islington, and several clever American operators, have for some time past made use of a slightly different method of giving the last polish to the plate. Their method is to procure a piece of very smooth and soft doeskin, and nail this on the buff instead of the cotton velvet, then well cover it with a quantity of the best rouge, quite dry, and with a clean brush (which should be used for this purpose alone) take out all the rouge. This is repeated two or three times, until no more dust can be brushed out; then, with the leather thus prepared, the plate is polished evenly all over, and with a very light hand. It is probable the first few plates will be slightly scratched, but after the leather has got black from the silver which has been rubbed into it, a most beautiful polish may be obtained, and, with care, not a single line or mark can be seen on the plate. Should the fingers accidentally touch the surface, or the buff get dirty in any way, it may be cleaned by means of a little rouge and a good brushing. With care, the leather will last for years and get better by use. It will be observed the peculiarity of this process is, that no powder is used to polish the plate with; this is carefully got rid of by the brushing. These buffs should be kept quite dry, and it is better to inclose them in a well closed box immediately after using. I have found it a great advantage to keep a little lime or fused chloride of calcium at the bottom of the box, at a little distance from the *surface* of the buff. If the buffs get at all damp, it is impossible to get fine black pictures, nothing so soon produces a cloudy appearance —a circumstance which many operators are frequently annoyed with.

12. Figs. 15 and 16 represent two forms of plate-holders or instruments for supporting the plate

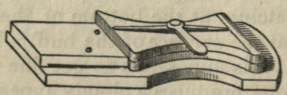
Fig. 15. Fig. 16.



while being cleaned and polished. Fig. 15 is an American pattern. It consists of a flat board, a trifle smaller than the plate, so as to allow the edges of the latter to project about one-sixteenth of an inch all round. The plate is secured by two small pieces of plated brass, one of which is moveable, and fixed by a screw attached to the opposite angle of the board. These pieces of silvered brass are rounded off, so that the buff should not be torn by passing over them. It is provided with a clamp, so that it may be fixed to the table. Fig. 16 is another very ingenious and simple form of plate-holder. It consists of a block of wood somewhat in the form of a dice-box. On one end is fixed by a single screw a piece of board a trifle smaller than the plate, this can be readily changed for larger or smaller as required; on the upper part of these boards is fixed one or more pieces of Indian rubber, the surface being melted by applying to it a hot iron. This renders the rubber permanently adhesive, so that the back of the plate when pressed against it adheres firmly; at the same time, when removed by a little force, the back is left perfectly clean.

13. Perhaps the best form of plate-holder is the one shown at fig. 17, and is much used in America, and particularly adapted for the thin French plates. It consists of an iron clamp, screwing down upon the edge of a block a trifle smaller than the plate to be cleaned. By a contrivance of the publishers of this

Fig. 17.



treatise, these blocks are made to shift, so that with one clamp and different blocks any size plate may be cleaned. They can also be reversed, so as to be buffed either way of the plate, or the plate-holder used for the lathe may be used for buffing by the hand, as shown in fig. 18. Having fixed the daguerreotype plate in one of the holders described, and previously bent the edges a little (which is easily and rapidly accomplished by the little apparatus represented at fig. 19), a little tripoli is sprinkled upon it, and a small piece of finely-carded cotton being folded into a round pellet or knot, is moistened with good olive oil, and the plate rubbed with it by a continuous circular motion until all scratches, mercury, or traces of the last picture disappear; the oil and tripoli are then wiped off with a clean piece of cotton, at the same time wiping the edges and back of the plate with a cloth; and in order to get rid of all appearance of oil, the plate should be rubbed upon a piece of cotton velvet until a fine black polish is obtained: now proceed to burn out the oil as directed (§ 9), and allow it to cool. A little very fine tripoli should then be dusted upon the plate, moistened with a few drops of spirits of wine; with a knot of cotton, rub the plate with a circular motion until the white film which appeared upon heating the plate has been removed, adding more alcohol if necessary; with another pellet of cotton, dry and clean off the tripoli. Water, acidulated with nitric acid, may be used (as originally recommended by Daguerre) instead of the alcohol; but we think it is more apt to stain the plate if not well

Fig. 18.

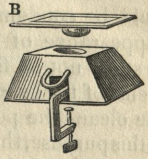
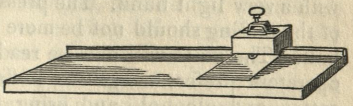


Fig. 19.



managed. Pure water, or weak solution of caustic potass, will answer equally well.

14. M. de Northomb asserts that alcohol in which a little caustic potass is dissolved gives the impression a fine tone of colour.*

15. The plate having been cleaned, but not polished, ought to present a uniform grey surface, without any stains or scratches; and if breathed upon, the vapour should be condensed in one uniform sheet on it. The disappearance of the film should be attended to; for any stain not at first visible will be indicated towards the end of the evaporation. Assuming that the plate is quite clean, the polishing process may be commenced. For this purpose, the plate may be fixed to one of the plate-holders, figs. 15, 16, 17, or 18, and briskly polished with the buff, fig. 14, (§ 11) always observing to give the final polish in a direction across the intended picture (10), and with a very light hand. The pressure at the termination of the buffing should not be more than the weight of the buff. The plate will now be ready for iodizing. Some operators prefer using two buffs, dispensing with the cotton and alcohol, and using the first buff in their place, on which they apply charcoal powder, and polish off the white film formed by heating the plate; with the second buff they give the final polish to the plate.

16. Rottenstone will do in the place of the tripoli. It may be prepared sufficiently fine in the following way:—Select a piece of rottenstone (not the powder) having a light buff colour, reduce the stone to powder in a mortar, and then throw it into a basin of clean water, allow it to stand a few minutes, and pour off the supernatent liquid, which will have in suspension all the finer particles of the rottenstone, the sand and coarser particles remaining at the bottom of the vessel. By allowing the liquid to stand a shorter or longer time,

* Lerebour's Traite de Photographie.

we may obtain the rottenstone of any degree of fineness. In order to get rid of the water, the liquid should be left undisturbed until it has become quite clear; the water should be carefully poured away, and the paste of rottenstone dried on a plate at the fire, or it may be used in this pasty state.

17. In France, the essential oils of bergamotte, citron, turpentine, lavender, or rosemary, have been much used for polishing the plates; and this plan is stated by M. Charles Chevalier, in his last work on the Daguerreotype, to be superior to all others.* This we believe to be quite true, provided we could obtain the essential oil quite pure, and free from adulteration with the fixed oils; but this is a difficult matter. It may be easily detected; for the essential oils are very volatile, and are dissipated at a very slight heat. The *fixed oils*, on the contrary, are not volatile; and on applying a strong heat, they decompose into gas, but do not volatilize: therefore, if we drop on a piece of paper suspected essential oil, it will cause a greasy stain; but on the application of heat to the under surface of the paper, the stain will disappear, and the paper appear as clean as before, if the oil is pure; but if there is the smallest quantity of fixed oil, the stain will still remain, notwithstanding the heat. One advantage the *pure essential* oils have in cleaning is this—the plate requires no burning.

18. The method recommended is to mix in a bottle some tripoli and oil of lavender; allow a drop of this mixture to fall upon the plate, then with a knot of cotton rub the plate for a little time, clean off the oil with a fresh piece of cotton and dry tripoli, and at once give the final polish with the buff. The following we have found to be a very ready and easy method of polishing, and it has this advantage, a

* Nouveau Renseignemens sur l'usage du Daguerréotype, par Charles Chevalier. Paris, Palais Royal, 163. 1846.

holder for the plate is not required; provide a smooth deal board about two feet long and eighteen inches in width, on this fasten a piece of clean cotton velvet of the same size; this velvet should be marked off into a number of divisions, each about the size of the ordinary buff; a board of the size directed may be divided into six parts, each four inches in width, and eighteen inches in length; each of these, although on the same board, is to be regarded as a distinct buff, and must be kept clean and free from the materials used on its neighbour. When we wish to clean a plate, the first buff on the right hand is to be dusted with some fine tripoli, and then moistened with a little of the best oil of turpentine (this essential oil may be had, under the name of *camphine*, at the oil shops); the plate should be laid with its face on the velvet, and rubbed quickly up and down, care being taken that the pressure exerted by the fingers on the back of the plate be not too much confined to one part. This should be particularly attended to when cleaning a thin French plate; but should any part of the plate be more difficult to clean than the rest, the pressure should be applied to the back just at that part. After a good surface is obtained, the plate should be passed on to buff No. 2, and rubbed until the whole of the turpentine and tripoli has apparently been removed. It may then be passed on to No. 3, on which a mixture of some very dry prepared charcoal and rouge has been dusted. On this buff the whole of the grain on the surfaces of the plate left by the tripoli should be removed, and a beautiful black polish left. In order to receive the finishing polish, and to "lay the grain" in the proper direction (§ 10, 11) it is to be passed on to No. 4, and rubbed briskly and lightly over the surface; on this buff the dry prepared charcoal alone is used. Care should be taken, before buffing a plate, that the buff, the charcoal, and rouge

are quite dry, *this is very important*, and particularly so when we make use of rouge as a polishing powder; if the rouge or the buff be at all damp, a red stain will appear in patches over the plate when we attempt to gild it (§ 11).*

19. After the plate has been cleaned and polished by any of the plans we have described, it is ready for the second process, viz., applying the iodine and other sensitive coatings; but previous to submitting it to the action of these substances, any particles of dust left by the polishing process must be removed. This is readily accomplished by passing lightly over the surface of the plate a knot of clean cotton, or a broad camel's hair tool similar to those used by gilders for the application of the gold leaf. It is advisable that the last buffing should be given only a short time previous to the iodizing, as it causes the plate to be much sooner iodized. Perhaps this is occasioned by the action raising, in a slight degree, the temperature of the plate. Care should be taken to apply the buff the last time as evenly as possible, or the iodine will be liable to attach itself to one part more than another. In order to remove this difficulty, Mr. Kilburn places his plate on a gas stove for a few seconds, previous to transferring it to his iodine box; by thus raising the temperature of the plate above that of the atmosphere, no moisture can be condensed on its surface. This is undoubtedly a great advantage; but the true reasons for the last polish being given to the plate just before its being used we believe to be this:—It is well known, since the publication of Moser's experiments upon the formation of images on metallic and other plates in the dark by "*invisible light*," that all bodies radiate a certain amount of organic matter, according to their degree of cleanness. Now, a daguerreotype plate, when clean, is just in a position to receive and condense this organic matter on its surface, which

* See § 81, for an account of the method of electro-silvering.

is injurious to its sensibility, and to the clearness of the resulting proof; this effect takes place in proportion to the *time* in which it has remained opposite a relatively impure surface. For this reason, the plate should be used directly after having been "buffed," or if not used immediately, it should be deposited in a *clean* plate-box. No plate-box should be used for a finished plate that has before been used for an oily or dirty one.

20. 2*d Process—Applying the iodine, and other sensitive coatings.*—For this purpose, the operator will require an—

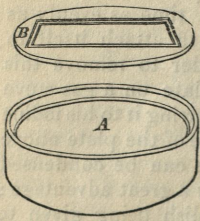
Iodine box or pan.

A bromine pan.

Some iodine and bromine, or other accelerating compound.

21. The most simple form of apparatus for applying the coating of iodine or bromine is shown in fig. 20.

Fig. 20.

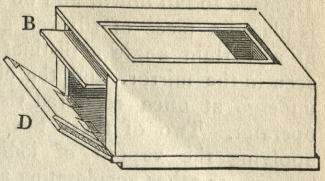


It consists of a porcelain pan, which may either be square or round. The round form, however, has this advantage, although it occupies more space: the frame holding the plate may be turned round during the operation of iodizing without taking it off the pan. By this means, the vapour may often be prevented attacking one part of the plate more than another. The edge is ground flat, and it is provided with a ground glass cover, fitting it air-tight. About three-eighths of an inch below the top, is a ledge on which rests a frame, B, made either of hard wood varnished, slate, or glass, for the purpose of holding the plate over the iodine or the solution.

22. This apparatus is sometimes made of a square form, and is fitted into a wooden box. This has some advantages. We believe it originated in France, and was there used for the application of the vapour of bromine. It is represented in fig. 21. It consists of a

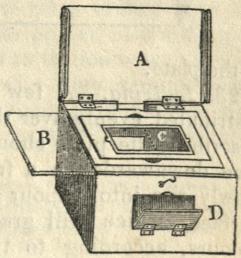
box, in the interior of which there is a shallow earthenware or glass pan, having a plate glass cover, B, fitting air-tight. This in the figure is shewn partly withdrawn. On the top of the box there is a ledge upon which rests the frame, to hold the plate whilst being prepared; one end, D, of the box is hinged, so as to allow the pan to be withdrawn if necessary. This is a very convenient apparatus; and we believe it to be the best, if we adopt the plan of determining the necessary exposure of the plate to the iodine and bromine by the *time* it is submitted to their influence (§ 28). But this plan is not always followed; for by a number of operators the original plan of Daguerre is adopted, viz., the plate is allowed to remain over the iodine and bromine vapour until a certain colour makes its appearance on the plate. For this purpose, an apparatus constructed similar to fig. 22 is used.

Fig. 21.



A is a mahogany box, inclosing a glass pan about three inches deep. On the top are a set of moveable frames to hold different sized plates. B is a piece of plate glass, which, sliding beneath the frames, serves as an air-tight cover to the glass pan. C is a portion of the back of the box made to slide out or fall down so as to admit a ray of light through a piece of white paper placed over this part of the glass. In front,

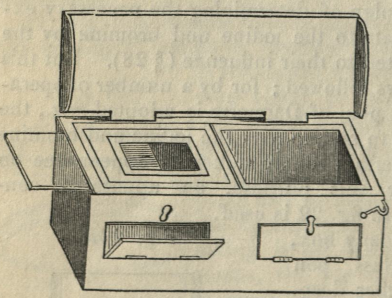
Fig. 22.



and immediately opposite to this opening, is a second, D, made to fall down, and on the inner portion of this is placed a piece of silvered glass, so that when held at a certain angle a distinct image of the plate is seen in the mirror, and the changes of colour it may undergo at once rendered visible to the eye of the operator. Two of these boxes are required, one for applying the vapour of iodine, the other for the bromine or other accelerating agent.

Fig. 23 represents another form of this apparatus, both pans being placed in the same box, the frame holding the plate sliding in a groove from the one to the other; each is provided with a distinct glass cover. The frames for the plates should be well varnished when made in wood, or they are liable to absorb the iodine and bromine vapour, and prevent its colouring the edge of the plate.

Fig. 23.



23. *Iodizing.*—A few crystals of iodine should be distributed evenly over the bottom of one of the pans described, the plate should then be carefully placed, face downwards, in a frame over it, the iodine will slowly rise into vapour and attack the clean silver surface, which will gradually assume a variety of colours, according to the thickness of the coating of iodine; the first tint which will appear upon the plate is a pale yellow; this colour gradually deepens until it assumes a deep golden colour; from

this it changes into very deep blood red,* and then immediately to pale rose; this rose tint deepens, and at last passes to a blue; by allowing the iodine to continue its action upon the plate, the blue gradually disappears and there is apparently little colour upon the plate, but in reality a yellow colour is again appearing, and if the action be still continued, the rose and blue again appear; in fact, the plate would assume a variety of colours, succeeding each other, just in the order of the first series.

24. Mr. Hunt has described a very interesting experiment on this subject. "If a piece of iodine be placed upon a silver plate and then gently warmed, a series of concentric coloured rings will make their appearance. The first ring, which is constantly spreading, forms the exterior of the circle, is of a bright yellow colour; within this there arises, successively, rings of green, red, and blue colours, and then again a fine yellow circle centred by a greyish spot occupied by the iodine. On exposing these to light, it will be found that the outer yellow circle almost instantly changes colour, and that the others slowly change in the order of their positions, whilst the interior yellow circle resists, for a long time, the solar influence. It is an instructive experiment to form these rings, and cover one-half and expose the other to light; we shall thus be led to appreciate the proper colour the plate should assume when exposed to the iodine vapour."

25. If iodine alone be used,† then it would appear that the second golden yellow colour is the most sensitive to light, but since the discovery of the accelerating

* These colours vary slightly when the light is allowed to fall upon the plate in a different direction. The deep blood-red is a colour very seldom seen; the plate must be very clean, and a good light must fall upon it for this tint to be visible.

† See an interesting paper by M. Claudet in the Phil. Mag., March 1848. He there states, the second yellow to be twenty-five times more sensitive than the first.

action of bromine or chlorine when combined with iodine on the plate, we have been led to believe that any of the *first series* of colours may be used on the plate provided we afterwards expose it for a *proportionate* time* to the bromine or chlorine; for instance, if we only allow the plate to assume a golden yellow colour, a very small quantity of bromine will make the plate very sensitive, but if the plate has been iodized to a full rose, then a larger quantity of bromine must be absorbed in order that the plate should be rendered sensitive; it is, therefore, obvious that any of the first series of tints may be used, provided the operator is able to apply the *correct quantity* of bromine. We think the best tint for iodizing is a *full* golden yellow, nearly approaching the rose; and this tint a novice is perhaps the best able to appreciate, for it will generally be found, however evenly and skilfully the plate has been polished, that on some part of it a rose tint has made its appearance, when the other part has arrived at a full golden yellow; the most convenient method of determining the proper colour, if the simple form of apparatus figs. 20 or 21 is used, is to allow a ray of light to enter the dark room and fall upon a piece of white paper; then to reflect the ray of light from the paper to the eye by means of the plate, and which, of course, will reflect its own colour only. We speak of "*the dark room*," but it is not essential that the iodizing process should be carried on in the dark, it is only a matter of convenience, for the eye is better able to appreciate the right tint when there is no other light but that reflected from the plate. With the apparatus, figs. 22 and 23, we have only to look on the mirror until we perceive the plate is of the proper tint, and then close the pan; this is a much more convenient plan, for it saves the trouble of lifting the plate from the pan every time we wish to observe the colour; after the plate has assumed the proper

* See table, § 28.

tint, it is then ready for the broming operation, which communicates the utmost degree of sensitiveness to the action of light.

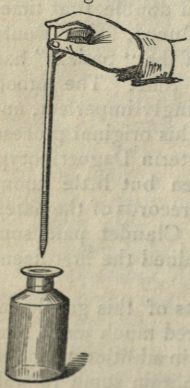
26. In the process, as originally described and patented by Daguerre, iodine alone was used for giving the plate its sensitive coating; for this purpose, he directed that, after the plate had been well polished, it should be submitted to the vapour of iodine, until it assumed a golden yellow colour, it was then ready for the action of light upon it, in the camera; and he stated, that if, by any inattention or mischance, the plate was suffered to go beyond this colour and assume a rose or blue tint, it should be rejected, and the whole process of polishing again gone through. The process with iodine alone was exceedingly slow; a portrait, which could be taken in ten seconds at the present time, would, if we followed the process of Daguerre, occupy at least half an hour, even with our improved forms of camera and object glasses; and if the patented camera of Daguerre were used, we do not think an image could be obtained in double that time. Of course, no portrait could be produced, for it would be impossible to obtain a likeness, if the "patient" had to sit quite immoveable for that time. The proofs obtained at this time were exceedingly imperfect, and if no advances had been made in this original process, we have very little doubt that the term Daguerreotype would, in a short time, have been but little known except to M. Daguerre, and by the records of the patent office. Fortunately, however, M. Claudet paid some attention to the subject, and obtained the first license for practising the art in England.

27. In some of the experiments of this gentleman, he found that the plate was rendered much more sensitive if it were exposed to chlorine, in addition to iodine; by this means he was enabled to obtain some tolerably good portraits. Since this time, the art has steadily progressed, and some of the proofs obtained by Kilburn,

Claudet, and Mayall, are astonishing specimens of sun-drawn pictures; views are now obtained absolutely instantaneously; in fact, in some cases it is impossible to open and shut the camera *too* quickly. In order that the plate should acquire this extreme degree of sensitiveness, various methods are adopted: but in all the different plans, the vapour of bromine is made use of, either alone or in combination with chlorine or iodine. These different methods we shall describe, beginning with the most simple.

28. *Bromine water.*—This may be prepared as follows:—pour into a glass stoppered bottle, nearly full of water, a few drops of bromine, and shake them together, the undissolved bromine will fall to the bottom, and the water will assume a bright red colour; one part of this clear solution is to be added to about forty parts of water. This is readily and accurately accomplished by means of the simple graduated tube shown in Fig. 24; or instead of using a measure, a certain tint of colour may be obtained, in common water, by adding the saturated solution, drop by drop, until the required tint is produced, which must be previously determined by experiment. A bottle of water, tinged with gamboge, may be kept as a standard of comparison.

Fig. 24.



Bromine water can be used in any of the pans we have described. After having obtained, by the iodine, a full yellow colour, we transfer the plate to the bromine, we shall find it will continue to change in a similar manner, as if we had left it over the iodine; from the yellow it will speedily pass to a rose, and if we continue the action, it will change to a

blue. By means of these changes, we ascertain the quantity of bromine applied to the plate. The following table shows the relative tints to be obtained on the plate when bromine water or the bromine of lime (§ 50) is used :—

1st Iodine.	Bromine.	2nd Iodine.
Straw colour.	Yellow.	Full yellow.
Light yellow.	Golden yellow.	Rose.†
Golden yellow.	Light rose.	Deep rose.
Blood red.	Damask rose.	Light blue.
Damask rose.	Deep rose.	Blue.
Deep rose.	Light blue.*	Indication of 2d yellow.‡

29. It will be observed, in the first column of this table, we have given the tints to be obtained by means of iodine ; the plate is then placed over the bromine water, until it assumes the proper colour for the particular tint to which it has been iodized ; this is indicated in the second column. After this, the plate should be again placed over the iodine, until the colour mentioned in the third column is obtained. Too much care cannot be taken to get these relative quantities of iodine and bromine correctly upon the plate, for if there is too *small* a quantity of bromine in proportion to the iodine, the plate will not be very sensitive to the light, and it will be impossible to bring a proof fully "out," without being *solarized.* (§ 69) Again, if we put on too much bromine, the sensitiveness also diminishes, the plate becomes covered with a veil, the mercury will be found to deposit itself very readily on every part of the plate where it ought not, viz. on the deepest shadows, and very often over the whole sur-

* This tint may be obtained by stopping the action when all the rose colour has just disappeared.

† This tint is either a pale rose or a blood red according to the light. See note to § 23.

‡ At this time there is apparently little colour upon the plate ; it is just at the time the last trace of blue has disappeared.

face; the "tone" of the proof is also very poor, and has a flat and cold, grey appearance, and the plate will be *very* liable to solarize.

30. There is a certain quantity of bromine necessary for each tint of iodine, and this exact quantity the photographer must obtain before he can expect a favourable result. If the full equivalent of bromine be applied, the operator will find that the proof will develop itself *very perfectly*, every part will be "done" enough, and *no part* solarized, even if the contrasts in the picture are very great; and the plate will also be found to be very sensitive, but, as a drawback to this kind of picture, the tone is cold and grey, the white parts are not very white and clear, and the whole has a flat appearance. This is the kind of picture generally obtained in France, and by the generality of American operators. If a *little less* bromine be applied, then the tone of the picture is changed; the white parts are very distinct and white, the shadows are very deep and black; this makes a fine bold picture; in the hands of some operators, this method produces the finest pictures, and is practised by some of our first English artists, but some care is required in the management of the light, and the direction it is thrown upon the model, for the plate is more apt to solarize when prepared in this way, than when it has the full proportion of bromine.

31. We have described, in the preceding paragraph, a method of applying the requisite quantity of bromine, by noticing the colour produced on the plate, just in proportion as the film of bromo-iodide of silver is more or less thick. This plan is generally followed in England, but in France the greater number of operators have hitherto adopted a method first described by M. Fizeau, in a pamphlet published in Paris by that gentleman. His method is, to expose the plate for a certain time to a solution of bromine of a determinate strength; the solution is renewed for each plate. This plan we shall proceed to describe.

32. To prepare a solution of bromine of an ascertained degree of strength, and adapted to the operations we are speaking of, the first thing to be considered is, the saturated solution of bromine in water; this saturated water is prepared by putting into a bottle pure water, and a large excess of bromine; shake the mixture well for a few minutes, and before using it let all the bromine be taken up.

33. An ascertained quantity of this saturated water is then diluted in a given quantity of pure water, which gives a solution that is always identical; this dosing is performed very simply, in the following manner:— take a small glass tube, having marked on it a line, measuring a small quantity, fig. 24. Have also a bottle with a similar line, measuring a quantity equal to forty times that of the tube; then fill the bottle of water up to the mark, and fill the tube also to the mark with the saturated solution of bromine; then add this measure to the bottle of water.

34. The proportions above mentioned have been established when calculating upon having perfectly pure water; but it is well known that the water of river springs is not pure; but these different kinds of water may all be used with equal advantage, by adding a few drops of nitric acid, until they have a very slight acid reaction; five or six drops per quart suffice for most kinds of water.

35. A bright yellow liquid is thus obtained, which must be kept perfectly air tight. It is the normal solution which we shall simply call bromine water, to distinguish it from the saturated water. The bromine pan should be flat-bottomed, and shallow; it should have an air-tight cover of plate glass. The form of apparatus, fig. 20, may be employed; the tube before mentioned being used for putting into the pan a determinate quantity of the bromine water; enough should be placed in the pan to cover the bottom of the vessel.

36. We have before stated, that the plate should be exposed to the bromine water of a certain strength, for a given time. Now, in order that the bromine water should be of the same strength in successive experiments, it is evident it must be renewed for each plate. This is the only practicable method of obtaining a constant quantity of vapour given off in the same time.

37. The time necessary for the plate to be exposed to the action of the bromine water, must be determined by experiment, for it will vary according to the size of the box, the quantity of liquid used, &c. It is usually between thirty and sixty seconds, and when once determined, it will be constant with the same box, and the same strength of solution.

38. The method of operating is as follows: place the pan upon a table, fill the pipette with bromine water, draw out a little way the glass slide, and allow the bromine water to run into the pan, and again close the vessel; the liquid must cover evenly the bottom of the pan; if not level, it must be adjusted; the level will be easily seen through the glass slide. When everything is thus arranged, the iodized plate is to be placed in its frame over the pan; the slide withdrawn, and the necessary time counted; after this has elapsed, the slide should be shut, and the plate immediately placed in the dark box of the camera.

39. For a second operation, this bromine water must be thrown away, and a fresh quantity used. The bottle containing the bromine water should be kept away from the direct light of the sun, and care should be taken that no organic matter fall into the bottle, such as grease, chips of cork, &c. These enter into new combinations with the bromine, and lead to error as to its amount in solution.

40. This plan is very good in the hands of a careful operator, who will pay attention to the little matters which are quite necessary to ensure success; but we are much inclined to prefer, if we use bromine

water, "working" to colour, in the manner recommended.

41. There are some solutions in which bromine is combined with chlorine and iodine, which are used as accelerating agents. The great difficulty experienced in the use of bromine water is, the small change of colour produced by its requisite action on the plate: now it is evident that, if we combine bromine in equivalent proportions with iodine, we may put rather more than twice the amount of colour on the plate we could if we used bromine alone, and still have the same amount of bromine on the plate; because rather more than one-half of the colour from the bromide of iodine will be due to its iodine alone, and the other half will be due to the bromine; by this means the change of colour will be much more distinctly seen, and a little more or less colour will not be of so much consequence as if we had used bromine alone; to this bromide of iodine we may add chlorine, forming chloro-iodide of bromine; this will take nearly another third part of the colouring on the plate.

We shall describe a few of these compounds, their use, and the method of making them.

42. *Bromide of Iodine.* — This compound is very easily prepared, as follows:—Introduce into a small bottle about a drachm of bromine, add to this iodine grain by grain, until the last quantity of iodine added does not dissolve; the bromine will then be quite saturated with iodine, any small excess of iodine will not do any harm, but may remain at the bottom of the vessel; when required for use, a few drops should be added to a bottle of water, until it assumes the colour of light sherry wine: the plate should be iodized to a clear yellow, and then exposed over this mixture until it becomes of a deep rose colour. If iodized more deeply, it should be exposed to the bromide of iodine for a longer period; this will be easily determined in a few trials; or it may be exposed to this solution for a certain time, in the same manner

as to the bromine water. This plan is strongly recommended by M. de Valicours in his excellent and very complete treatise on the daguerreotype.* He gives the following directions for its use in this way.

43. The plate having been iodized either to a deep yellow, just changing to a rose (*transition due jaune au rose*), a bright rose, or a very dark rose or violet, pour into the pan a quantity of diluted bromide of iodine of which the strength is known, sufficient to cover all the bottom of the pan; after about a minute has elapsed, place the plate over the vessel, and begin to count seconds; the time will, of course, vary according to the size of the vessel, the strength of the solution, &c.; however, as some indication of the requisite time, we may state, for a plate iodized to a deep yellow, thirty or forty seconds, a bright rose forty or fifty, for the deep rose or violet fifty or sixty seconds may be required.

44. M. Claudet uses the bromide of iodine, but in an extremely diluted state; he makes the solution so weak that it requires about half an hour to apply the requisite quantity of vapour, and his argument is very plausible; he states that by this plan there is a much greater certainty of obtaining an uniform quantity of the mixed vapours on the plate, for a few seconds, or even a minute or two, more or less, does not make so much difference to the plate, as a second or even half of one, does, when the solution is used very strong; he uses numbers of small earthenware pans, not inclosed in any case, to hold the solution, and prepares either eight or sixteen plates, according to their size, at one time.

45. When the bromide of iodine is used, it is better on the first trial to observe the colour of the plate, and at the same time notice how long it takes to attain that colour with a certain strength of solution; by this means it is very easy afterwards to prepare a number

* Galvanoplastie et Daguerreotype, par M. de Valicours.

by merely exposing them for the observed time over the bromide, for the mixture is very constant in its action, and remains so for some time. There are various methods of preparing bromide of iodine recommended; but we have given the only one by which constant results can be obtained; for if we adopt some of the other plans, the operator is never certain of obtaining the same amount of bromine on the plate each time, the bromine evaporates and leaves merely iodine in solution; this *colours* the plate equally as well as the bromide of iodine, but of course communicates to it no sensitiveness.

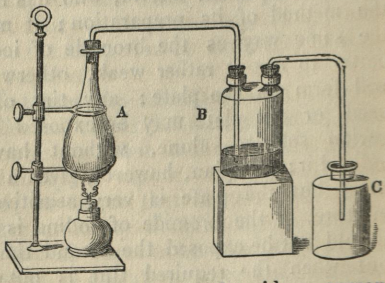
46. *Hungarian solution.*—This is a very favourite solution with most amateurs, and deservedly so. It was invented by M. Guérin, who has retained a secret the method of its preparation; it may be used in the same way as the bromide of iodine, but it is better to use it rather weak, otherwise small spots will form on the plate; any tint of iodine may be used, or the plate may be exposed over the Hungarian solution alone, without having previously iodized it; this plan, however, gives a very grey, poor tone, but the plate is very sensitive. When this mixture, or the bromide of iodine is used, the plate should not be exposed the second time to the iodine; but when the required tint is obtained, the plate should be carefully placed in the camera box; this removal, of course, should be performed in a dark room.

47. *Wolcott's accelerating mixture.*—This mixture is a very good one, and employed by Mr. Beard at all his establishments. It consists of chlorine in combination with bromine. We are not acquainted with the exact method of its preparation; but a mixture not unlike it may be made by dissolving bromine in a mixture of two parts muriatic acid, and one of nitric acid, the bromine is added to this until it will dissolve no more. The red liquid thus obtained is to be decanted from any excess of bromine, and when re-

quired for use, two drachms should be mixed with eight ounces of water, allowed to remain for about half an hour, and then used in the apparatus, fig. 20; the same tints should be obtained on the plate as directed for bromine water. (§ 28)

48. *Chloride of bromine.*—This may be prepared by passing a current of chlorine through a vessel containing bromine, by means of the apparatus fig. 25. A mixture of two parts muriatic acid, and one of black oxide of manganese, should be placed into the flask A. To this flask a bent tube is adapted, passing through an opening in the two-necked bottle B. This tube should dip into a little bromine placed in the bottom of it; another tube should proceed from this, and just dip below the surface of some water in another vessel C; a very gentle heat is then to be applied to the flask containing the manganese and acid, a current of chlorine gas will pass through the bromine contained in B; in a short time the bromine will change colour, and a volatile yellowish-red fluid is obtained; this should be diluted with water and used in the same way as Wolcott's mixture. In this and all accelerating solutions *not* containing iodine, the plate should be placed over the iodine a second time, as directed for bromine water. (§ 28) Chloride of iodine may also be prepared in this apparatus. Iodine should be placed in vessel B, and then gently heated; when the current of chlorine is passed,

Fig. 25.



the lamp may be removed from the iodine; the action should be stopped after the liquid produced becomes of a brownish-red colour.

49. We shall conclude our notice of accelerating compounds by an extract from the *Philosophical Magazine*, in which we have described a method of using bromine which possesses many advantages; the arrangements, fig. 22 or 23, are the best adapted for this compound; if an earthenware pan is used, it should be thoroughly dried, this is readily accomplished, by placing it in a common oven at a moderate heat for about an hour, this will effectually remove the moisture out of the substance of the pan, which it is very necessary to get rid of, for after the vessel has been used for containing liquid of any kind, it obstinately retains moisture, which infallibly spoils the bromide of lime if placed in it.

50. "'*An improvement in the Daguerreotype process by the application of some new compounds of bromine, chlorine, and iodine, with lime.*'*—All persons who have practised the daguerreotype must have remarked, that in warm weather a considerable deposition of moisture takes place upon the glass or slate cover used to confine the vapour in the bromine or accelerating pan. This moisture must also necessarily condense upon the cold metallic surface of the plate during the time it is exposed to the bromine vapour. In fact, I have been informed by a number of professional daguerreotypists (and I have experienced the difficulty myself), that they were unable to obtain perfect pictures during the excessive heat of the late season; and a very clever and enterprising operator, who last year made a tour on the continent, and brought home some of the finest proofs I have ever seen, entirely failed this season in obtaining clear and

* By R. J. Bingham, Chemical Assistant in the Laboratory of the London Institution.—From the *London and Edinburgh Philosophical Magazine*, for October 1846. Communicated by the Author.

perfect pictures, from the constant appearance of a mist or cloud over the prepared surface. This appears to be caused by the deposition of moisture upon the plate, arising from the water in which the bromine is dissolved. To obviate this, some have recommended the pan to be kept at a low temperature in a freezing mixture: and M. Daguerre, in a communication to the French Academy of Sciences, recommends the plate to be heated: but in practice both these plans are found to be unsuccessful. (See Lerebour's *Traité de Photographie.*)

51. "It appeared to me, that if we could avoid the use of water altogether in the accelerating mixture, not only would the difficulty I have mentioned be avoided, but a much more sensitive surface would be obtained on the plate. With this view I endeavoured to combine bromine with lime, so as to form a compound analogous to bleaching powder. In this I was successful, and find that bromine, chloride of iodine, and iodine, may be united with lime, forming compounds having properties similar to the *so-called* chloride of lime.

52. "The bromide of lime* may be produced by allowing bromine vapour to act upon hydrate of lime for some hours: the most convenient method of doing this is to place some of the hydrate at the bottom of a flask, and then put some bromine into a glass capsule supported a little above the lime. As heat is developed during the combination, it is better to place the lower part of the flask in water at the temperature of about 50° F.: the lime gradually assumes a beautiful scarlet colour, and acquires an appearance very similar to that

* I call this substance bromide of lime, although there is a difficulty as to the composition of bleaching powder, and which would also apply to the compounds I describe. Some chemists regard the *chloride of lime* to be a compound of lime, water and chlorine. Balard thinks it is a mixture of hypochlorite of lime and chloride of calcium; and the view of Millon and Prof. Graham is, that it is a peroxide of lime, in which one equivalent of oxygen is replaced by one of chlorine.

of the red iodide of mercury. The chloro-iodide of lime may be formed in the same manner: it has a deep brown colour. Both these compounds, when the vapour arising from them is not too intense, have an odour analogous to that of bleaching powder, and quite distinguishable from chlorine, bromine, or iodine alone.

53. "Those daguerreotypists who use chlorine in combination with bromine, as in Wolcott's American mixture, or M. Guérin's Hungarian solution, which is a compound of bromine, chlorine, and iodine, may obtain similar substances in the solid state, which may be used with great advantage. By passing chlorine over bromine, and condensing the vapours into a liquid, and then allowing the vapour of this to act upon lime, a solid may be obtained having all the properties of the American accelerator; or by combining the chloro-iodide of lime with a little of the bromide, a mixture similar to that of M. Guérin's may be produced: but I greatly prefer, and would recommend the pure bromide of lime, it being, as I believe, the quickest accelerating substance at present known. By slightly colouring the plate with the chloro-iodide, and then exposing it for a proper time over the bromide, proofs may be obtained in a fraction of a second, even late in the afternoon. A yellow colour should be given by the use of the first substance; and the proper time over the bromide is readily obtained by one or two trials.* With about a drachm of the substance in a shallow pan, I give the plate ten seconds the whole of the first day of using the preparation, and add about three seconds for every succeeding one. The compound should be evenly strewed over the bottom of the pan, and will last with care about a fortnight.

* It is better to count time both over the iodine and the bromide of lime; the exposure of the plate to the iodine, after it has received its proportion of bromine, should be one-third of the time it took to give it the first coating of iodine. We have found that if less iodine than this be allowed to the plate it will not take up so much mercury, neither will the picture produced be so bold and distinct (28, 29, 30).

54. "The great advantage of this compound is, that it may be used continuously for a fortnight without renewal; and, unlike bromine water, its action is unaffected by the ordinary changes of temperature.

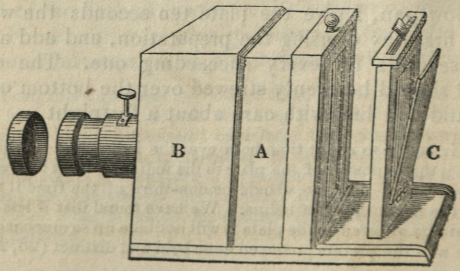
"I have hastened to communicate this during the present fine weather, believing that it will be acceptable to all interested in this beautiful application of science."

We now come to the third operation, namely, obtaining the impression on the plate by means of the Camera.

THE CAMERA.

55. *Camera.*—This apparatus we have before described in Part I, as adapted more particularly for the processes on paper, and the only modification absolutely necessary to render the same instrument useful for the daguerreotype is the frame for holding the plate in the place of paper during the time it is exposed to the light; however, as it is more convenient to have a camera purposely constructed for the daguerreotype, we shall proceed to describe two or three of the forms best adapted for this process. Fig. 26 represents one form, half the body A sliding into

Fig. 26.

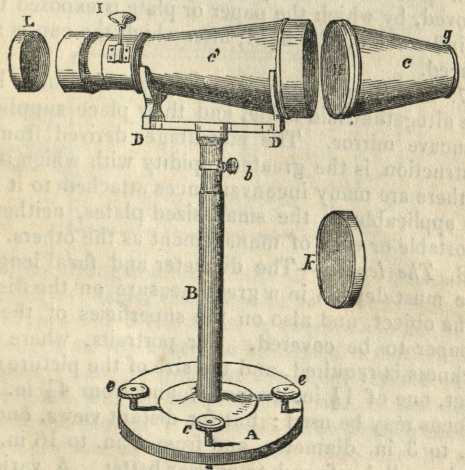


the other half B, this has the advantage of rendering the instrument more portable and allowing a greater range of focus, and, if required, lenses of different focal lengths can be used with the same camera.

56. Fig. 27 represents the German, or Voigtlander's Camera; it is made entirely of brass, so that variation of climate has no effect upon it. It is very portable, and when packed in its box, with all the necessary apparatus and materials for practising the Daguerreotype art, occupies but little space.

The brass foot A, is placed on a table, or other firm support, and the pillar B screwed into it; the body of

Fig. 27.



the camera *c c* is laid into the double forked bearing D D. The instrument is now properly adjusted by means of the set screws *e e e* in the brass foot, or it may be raised, lowered, or moved from one side to the other, by the telescope-stand, and when correct, fixed

by the screw *b*. The landscape or portrait to be delineated is viewed either through the small lens *g*, or with the naked eye on the ground glass plate H, the focus being adjusted by the screw I. The optical part of the instrument consists of the small set of achromatic lenses presently to be described. When the view or portrait to be taken is delineated on the ground glass to the entire satisfaction of the operator, the brass cap L is placed over the lens, and the entire body is removed away into the dark, taking care not to disturb the position of the stand. The body is now detached at the part H, and the plate inclosed in the brass frame *k* introduced in its place; the whole is again placed on the pedestal, the brass cap L is removed, by which the paper or plate is exposed to the full influence of the light, after which the cap is again replaced.

57. Mr. Beard patented a camera in which lenses were altogether laid aside, and their place supplied by a concave mirror. The advantages derived from this construction is the greater rapidity with which it acts, but there are many inconveniences attached to it; it is only applicable to the small-sized plates, neither is it so portable or easy of management as the others.

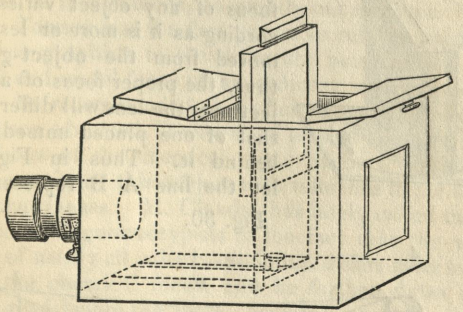
58. *The lenses.*—The diameter and focal length of these must depend in a great measure on the distance of the object, and also on the superficies of the plate or paper to be covered. For portraits, where great quickness is required, and the size of the picture not an object, one of $1\frac{1}{2}$ in. diameter, and from $4\frac{1}{2}$ in. to $5\frac{1}{2}$ in. focus may be used; but for distant views, one from 2 in. to 3 in. diameter, and from 8 in. to 16 in. focal length, will be found to answer better. A variety of moveable apertures or diaphragms are often useful, as by them the intensity of the light may be modified, and more or less distinctness and clearness of delineation obtained.

59. Though the single achromatic lens answers very

well for copying engravings, taking views from nature, buildings, &c., for the portrait, figures, and groups from life, it is almost entirely superseded by the double achromatic, which acts very much quicker. These have been brought to great perfection by M. Voigtlander, of Vienna, under the direction of Dr. Petsval, Professor of Mathematics in that University.

60. Fig. 28 shows the American form of camera, modified by Messrs. Knight and Sons; it is a very

Fig. 28.



convenient arrangement; admits of great variation in the length of focus, and may be used for copying daguerreotypes where the focus is required to be of the same length as the object to be copied is distant from the object glass; in this case the image formed on the ground glass will be of the same size as the object at which the camera is directed. The plate frames in this camera are so made that the plate can be used either in a horizontal or vertical position without the trouble of turning the camera on its side, and a considerable number of these frames containing the prepared plates, can be packed within the camera.

61. Another, and a very important improvement in this camera has been made by the last-named gentle-

men, namely, a readier and less expensive contrivance for altering the position of the plate with respect to the object-glass, by which means two objects, differing slightly in their distance from the object-glass are brought to the same focus on the ground glass or plate. Fig. 29 represents the moveable frame for the purpose.

62. We shall endeavour to explain the advantage derived from occasionally placing the plate out of its upright position. It is well known that the focus of any object varies according as it is more or less removed from the object-glass; thus, the proper focus of an object near the lens will differ from that of one placed immediately behind it. Thus in Fig. 30, let the line A B represent an

Fig. 29.

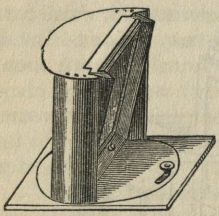
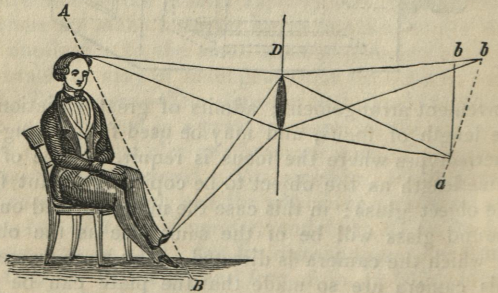


Fig. 30.

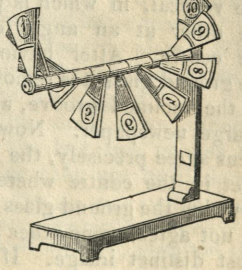


object situated obliquely to the lens D, the point A will have its focus behind the lens at *a*, the point B being nearer the lens will have its focus at a greater distance, at *b*. Now, by the ordinary arrangement of camera, only one of these points, as *a*, could be obtained correctly in focus, the line *a b* representing the ground glass, but by

making the back of the camera moveable, we can place the ground glass as indicated by the dotted line *a b*; therefore, both these points, *a b*, or any part of the object on the line A B, will thus be in correct focus, and both the face, knees, and hand of the sitter drawn in the figure, will be properly represented; this is, to a certain extent, a great advantage, and particularly so with a short focus lens having a large opening, but it will also be at once perceived that the only parts *properly* in focus will be where the line A B touches the figure, the pattern of the waistcoat would, in this instance, be slightly out of focus.

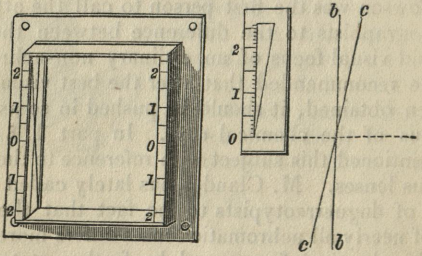
M. Towson was the first person to call the attention of photographists to the difference between the chemical and visual focus of an ordinary non-achromatic lens; he recommended that after the best visual focus had been obtained, it should be pushed in so as to get the focus of the chemical rays. In part 1, § 45, we have mentioned this subject with reference to the single meniscus lenses. M. Claudet has lately called the attention of daguerreotypists to the fact that the visual focus of nearly all achromatic lenses differs more or less from the chemical focus, and he further states (in a paper read before the Royal Society), that this chemical focus with the same lens varies every day. Now, as it is a most important matter to ascertain the exact focus of every lens, M. Claudet and Mr. Knight have each devised an apparatus for ascertaining this with precision. M. Claudet's apparatus is shewn at fig. 31. This consists of a series of screens having some black lines on them, placed

Fig. 31.



at different distances from each other round a circular piece of wood; this apparatus is placed opposite to the camera, and the lense adjusted until one, say the centre, is clearly defined on the ground glass; an impression is then taken, when probably the one most clearly defined on the ground glass will be the most indistinct, and a screen some inches behind will be clearly impressed, the distance between these two will give the difference between the visual and chemical focus. Mr. Knight's apparatus is represented at fig. 32,

Fig. 32.

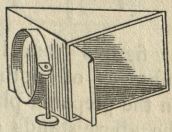


and is extremely simple and portable; it consists of a brass frame, which is attached to the back of the camera in the place of the ground glass; there are two grooves, one vertical, in which is placed the ground glass, and the other at an angle cutting the vertical one in the centre. After having obtained the focus upon the ground glass it is removed, and the plate introduced in the inclined groove, and an image is impressed of a large newspaper. Now, if the chemical and visual focus agree precisely, the writing will be the most distinct in the centre where it cuts the vertical groove in which the ground glass was placed; but if the two foci do not agree, some other part of the plate will have the most distinct image. If the chemical focus be longer than the visual, the most distinct image will be on that part of the plate inclining away from the lens, and at

some part of the plate corresponding with the amount of error; this amount can be read off in decimal parts of an inch by means of a scale at the side of the brass frame, and after having accurately obtained this distance, it is easy afterwards to move the tube containing the lense in or out a distance corresponding to the division of the scale indicating the deviation of the true from the photogenic focus.

63. Fig. 33 represents a mirror for reversing the sides of the image, and is to be fitted on to the end of the object-glass; this is necessary when we wish the objects represented to appear in the same position as they do naturally; thus, if we point the camera at a man writing, in the representation his pen will appear to be held in the left hand, but if the mirror be used, the sides will be reversed and the pen appear in the right hand; a glass prism is sometimes used for this purpose, but it is very much more expensive and difficult to obtain perfect and free from striæ; it is true there are two reflections, and, therefore, two images formed on the ground glass by the mirror, one image being formed by reflection from the surface of the mercury at the back of the glass, and the other a faint image from the surface of the glass, but, practically, this is of little importance, for the latter image is seldom of sufficient intensity to impress the plate. When the mirror is used, it lengthens the time of exposure of the plate about one-half as much again.*

Fig. 33.

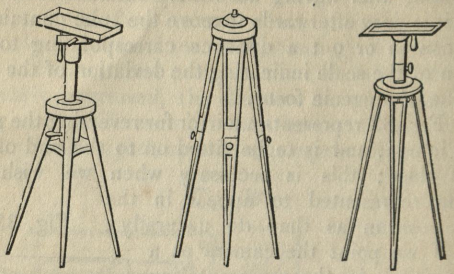


64. Figs. 34, 35, and 36, show three different forms of the camera stand, the last two possess the advantage of portability, hence they are best adapted

* Mr. Armitage, of Louth, has for some time used a metallic speculum instead of a mirror, in order effectually to get rid of the double reflection. We have seen some extremely sharp and clear pictures produced by this means.

for the tourist taking views from nature: the first however, is the better suited for taking portraits

Fig. 34. Fig. 35. Fig. 36.

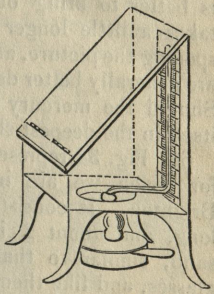


or figures from life, and the last combines the advantages of both. In order to obtain an image on the prepared plate, the camera is placed on one of the above stands opposite to the object, an image of which will be formed on the ground glass more or less distinct; the lens should then be moved by the rack and pinion to or from the ground glass until a clear image is obtained. The glass is then removed and the frame containing the plate introduced in its place, the slide is next withdrawn and the light allowed to act upon the prepared surface, the proper time for the light to act upon the plate depends upon so many circumstances, the hour of the day, the season of the year, and the preparation of the plate, that it is impossible to give any rule; but the time, with a good lens, a bright day, and a properly prepared plate, in the open air, ought not to exceed ten or fifteen seconds; after the proper time has elapsed the frame should be closed, the plate taken out of the camera, and submitted to the next operation, namely, bringing out the picture by the vapour of mercury, for if the plate is examined after the necessary action of light, no picture will be perceived.

We come now to the fourth operation, rendering the impression obtained in the camera visible by the aid of mercury.

65. Fig. 37 represents an apparatus for this purpose. The box is made of wood of the form represented in the figure. The bottom is of iron, slightly dished in the centre; this is for containing a small quantity of mercury, the bulb of a thermometer dips into this, the stem being bent in such a manner that the scale comes outside the front of the box, the mercury being heated by the spirit lamp. The thermometer indicates the temperature obtained. The plates are supported in a groove, placed for this purpose inside the lid; this process is generally carried on in a dark room, but the box may be so contrived as not to render this necessary, the dark frame fitting the camera and containing the plate being made so as to adapt itself to the top of the mercury box, so that when placed in it, the slide may be withdrawn as in the camera. When required to be very portable, the legs are made to fold beneath the box, the plate may be examined from time to time by raising the lid and allowing a light from a bull's-eye lantern to fall upon the plate for a short time.*

Fig. 37.



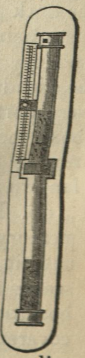
66. The plate should be allowed to remain in the mercury-box until the picture is fully developed, or until it will take up no more mercury. This is readily seen; for when the picture has been in the mercury-box too long, the shadows begin to turn grey, and are covered with very minute particles of mercury. The proper time for the plate to be removed is just before this effect takes place. It is better to allow the plate

* It is convenient to tie up the mercury in a little bag and place it over the bulb of the thermometer.

to remain over the mercury as long as possible; for by so doing the picture acquires a more clear and white appearance. Should there be any small trace of solarization, a prolonged exposure to the mercury will sometimes remove it. The heat to be applied to the mercury-box should not exceed 200° Fahrenheit: it is better to bring out the picture at about 150°; it takes a little longer time, but there is less risk of spoiling the picture, and it will be found that the details are generally better developed by employing a low heat. Should the mercury be made *too hot*, it will deposit itself in the deepest shadows, and spoil the proof.

68. Fig. 38 represents a sand-clock, or timekeeper, for which we are indebted to Mr. Constable, of Brighton. It consists of a glass tube, 10 or 12 inches long, and about 1 in. diameter, half-filled with fine sand, similar to that used for the ordinary minute glasses, and like them it has a diaphragm with a small hole in the centre, through which the sand runs. The tube is attached to a board by a centre, on which it turns. On the upper portion of this board, and on one side, is a scale, graduated into minutes and seconds, provided with a moveable index. The instrument when in use is fixed firmly, and perfectly upright to the wall; the tube being revolved on its centre, the index is set to the number of minutes and seconds required to be marked. In practice, it will be found more convenient than a clock or seconds watch, and is applicable for either the mercury-box or bromine pan. (§ 31, 66)

Fig. 38.

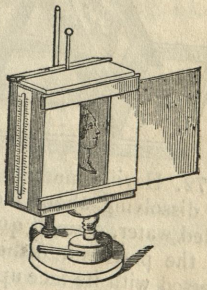


69. As the picture is brought out, or rendered visible by the mercury, it will be readily seen whether the plate has been exposed a sufficient time in the camera; for if those parts most illuminated only appear very distinctly, then we shall be certain it has been too short a time in the camera; but should it have been left the right period, the first effect of the mercury will

develop the whole of the picture, but very faintly, and further mercurializing will develop it strongly. But if the plate has been too long exposed in the camera, it will have a blue appearance in those parts most illuminated by the sun, and if the exposure has been still longer, the lights and shades of the picture will be reversed. The blue appearance given by the too-prolonged action of light is technically called "solarization."

70. There are several forms of mercury-box. Fig. 39 represents a very portable one. It was the opinion of Daguerre that the mercurial vapour could only be properly applied to the plate at an angle of 45°, and mercury-boxes are still generally constructed for the plate to be held at this particular angle; but this is not of the slightest consequence, for a plate may be mercurialized in any position, and we have used a mercury-box made from an old plate-box, where the plates are held vertically. This form of mercury-box occupies very little space, and a number of plates can be mercurialized at once. The plates can be observed by drawing up the rod on the bottom of which each plate rests, or by having a piece of yellow glass in front of the box. All mercury-boxes should have stout iron bottoms. Some are made out of thin sheet iron: these retain the heat a very little time, and the operator has the trouble of heating them every few minutes. When made thick, they retain their temperature constant for some time when once heated, and a small flame may be allowed to burn under them without any danger of the bulb of the thermometer breaking. There is also an arrangement by which the mercury-box can be raised or lowered to or from

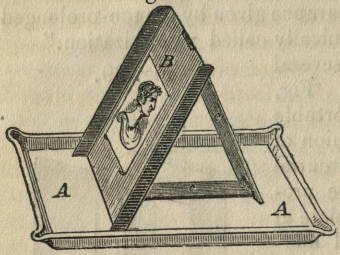
Fig. 39.



the lamp until it is found the temperature remains constant.

71. *5th Operation.—Removing the Sensitive Coatings of Iodine and Bromine.*—For this process the following apparatus is required:—

Fig. 40.



Two or three porcelain vessels of the form A, fig. 40.

A pair of plyers for small plates, and the support B, fig. 40, for large ones.

Hyposulphite soda, and distilled water.

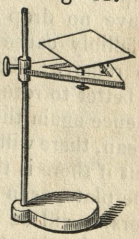
72. Having made a solution of hyposulphite of soda by dissolving about 1 oz. of the salt in a pint of distilled water, a small quantity should be poured into one of the porcelain dishes, and the plate suddenly immersed with its face upwards, the whole of the coloured coating of iodine and bromine will be promptly removed. The plate is then taken out, and placed in a vessel of distilled water until the next and final operation. On removing the plate from the mercury-box, it should be kept in the dark until the sensitive coatings are removed, as the light darkens them, and renders the operation more difficult.

73. Sixth and last process, viz.—Fixing the picture by means of a coating of gold, and drying the plate. The only apparatus required for depositing the film of gold on the plate, is a levelling stand and a small glass funnel; some hyposulphite of gold, or crystallized chloride of gold, and hyposulphite of soda and distilled water.

74. If the double salt of hyposulphite of gold be used, 15 grains of it are to be dissolved in a pint of distilled water. But if the crystallized chloride of

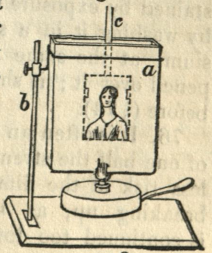
gold and hyposulphite of soda are obtained separate, then 15 grains of the former are to be dissolved in a pint of distilled water, and in another pint of distilled water 45 grains of the latter; pour gradually, in very small quantities, the gold into the hyposulphite, stirring the solution all the time, when finished the mixture should be nearly colourless, the plate being removed from the distilled water in which it was placed, and whilst still wet, should be placed on a fixing stand, fig. 41. A little filtering paper is then to be placed in the glass funnel, and the gold solution poured into it, and allowed to drop on the plate. As much solution should be placed on the plate as it will hold: should it not be level, it is adjusted by the levelling screws. A small spirit lamp flame should then be applied to the under surface of the plate, and kept in motion, so as to heat all parts of the plate alike. Small bubbles will form, and the image will assume a dark appearance; presently the picture will brighten, and a great intensity of light and shade will be produced, the gold should then be poured off, and the plate well washed with distilled water, it now only requires drying.

Fig. 41.



75. The apparatus (fig. 42) may be used for this purpose. *a* is a vessel of sufficient size to take the largest plate, but not more than half an inch in width; it is best made of copper or brass, tinned or plated inside, which must be kept perfectly clean; hot distilled water is poured into it, and the temperature kept up by the spirit lamp. The plate supported by the holder *c* is immersed and then gradually withdrawn, at the same time the operator should

Fig. 42.



gently blow upon the surface, it may by this method be brought out perfectly dry. Small plates are readily dried, by holding them by one corner with the pliers, and pouring hot distilled water on them, applying the spirit lamp to the back at the upper corner, at the same time facilitating the operation with the breath, passing the lamp gradually downwards, finishing at the extreme corners. The last drop may be removed by a little bibulous paper, the film of water must dry off evenly, and leave no drop behind on the surface, for this would infallibly cause a stain which it would be difficult to remove; should a drop separate from the rest, it is better to return the plate into clean water, and commence again the drying operation; if the plate be quite clean, there will be no difficulty in drying off the picture, but if there is the smallest quantity of grease either on the plate, or in the water, or communicated by the fingers, it will be impossible to get the water off properly, the only plan to adopt in this case is to pour over the plate a little strong alcohol, and *slightly* wipe the plate at the same time with a camel's hair pencil; the alcohol should then be washed off with water until no striæ appear on the plate, and then another attempt made to dry the picture. The proof is now finished, and in order to preserve it, should be put into a plate-box, and kept from the air, or it may at once be mounted in a paper or other frame, of which several varieties may be obtained. An old picture injured or stained by exposure to air, may very often be cleaned by washing it in a solution of the cyanide of potassium, at the same time passing a soft camel's hair pencil over it; it should then be washed and dried as before (§ 74).

76. It is often an advantage to use the gold solution of one-half the strength before recommended, there is less risk of the film of gold becoming too thick and breaking up, as is often the case when the heat is continued too long; another advantage is, that it

enables the operator to "*gild down*" a stain which often appears at the beginning of the gilding process; for by continuing the heat there is very little danger of exfoliation of the gold, and the stain very often disappears; the operator will soon discover the kind of stain which will disappear by continued gilding; if there are any traces of oil left in the plate by the cleaning process, white stains will appear; these cannot be got rid of by continuing the gilding, they get worse, and if they appear, it is very little use proceeding farther with the proof, for it will only render it more difficult to clean.

77. Solarization may often be removed by long application of heat, using weak gold; but a better plan for removing slight solarization, is to deposit a *thin* film of silver upon the plate by means of the galvanic battery, the conducting wire from the zinc end of the battery should be connected with the daguerreotype plate, the opposite silver electrode placed in the solution, and when all is ready the plate is to be dipped into the silvering liquid for about two seconds only, if left in the solution longer than this time, a thick film will be deposited, and the proof clouded (full directions for electro-silvering will be found in Electrotype Manipulation, published by Messrs. Knight). After the plate has received this silver coating, it should then be gilded as before described; if carefully managed, this will be found a very good method of removing solarization.

78. The gilding can also be accomplished by electricity, and this gives a very warm tone to the picture, this plan may be used by the artist to modify his results. Mr. Beard fixed all his proofs in this way at one time, but we believe he has now abandoned the plan.

79. *Colouring Daguerreotypes.*—It has often been asserted that this has been accomplished by solar influence alone, but we think without any foundation.

All the colouring in daguerreotypes is applied by the pencil. For this purpose, the artist will require a few colours in the state of an impalpable powder, having been ground up with a little gum-arabic and spirits of wine, and then dried. The principal colours used are ultramarine, carmine, chrome-yellow, and Prussian blue. A little of the colour should be taken up on the point of a fine camel's-hair pencil, and applied by a slight circular motion to the parts we wish to tint, which should then be breathed upon, and the superfluous colour dusted off by a thicker camel's-hair pencil. If the colour is not deep enough, a little more of the powder should be applied, and the plate again breathed upon and dusted off. By combining these colours, any tint we wish may be obtained: any *slight* lines or *spots* of colour may be applied in the wet state, in the same way as ordinary water-colours; but only a *very small* quantity should be used. The general fault with amateurs is, that they use too much colour—but, unless in very skilful hands,* we think a coloured daguerreotype is a spoilt one: it is something analogous to painting a fine engraving.

80. We have some doubts as to the propriety of noticing the following process for colouring daguerreotypes, proposed by Professor Page of New York:—†

"The impression being obtained upon a highly-polished plate, and made to receive by galvanic agency a very slight deposit of copper from the cupreous cyanide of potassa (the deposit of copper being just enough to change the colour of the plate in the slightest degree), is washed very carefully with distilled water, and then heated over a spirit-lamp until the light part assumes a pearly, transparent appearance. The whitening and cleaning up of the picture by this process is far more beautiful than by the ordinary method of fixa-

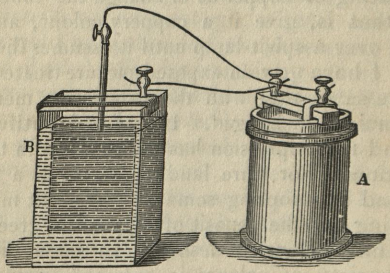
* M. Mansion, a very clever artist, has however succeeded in producing some very fine coloured daguerreotypes.

† Silliman's Journal of Science.

tion by a deposit of gold. A small portrait, fixed in this way more than a year since, remains unchanged. As copper assumes various colours, according to the depth of oxidation upon its surface, it follows, that if a thicker coating than the first mentioned can be put upon the plate without impairing the impression, various colours may be obtained during the fixation. It is impossible for me to give any definite rules concerning this last process; but I will state, in a general way, that my best results were obtained by giving the plate such a coating of copper as to change the tone of the picture—that is, give it a coppery colour, and then heating it over a spirit-lamp until it assumes the colour desired. I have now an exposed picture treated in this way at the same time with the two above mentioned, and it remains unchanged. It is of a beautiful green colour, and the impression has not suffered in the least by oxidation. For pure landscapes, it has a pleasing effect; and by adopting some of the recent inventions for stopping out the deposit of copper, the green colour may be had whenever desired. In some pictures a curious variety of colours is obtained, owing to the varying thickness of the deposit of copper, which is governed by the thickness of the deposit of mercury forming the picture. In one instance, a clear and beautiful ruby colour was produced, limited in a well defined manner to the drapery, while all other parts were green. To succeed well in the first process, viz. that for fixation and the production of the pearly appearance, the impression should be carried as far as possible without solarization; the solution of the hyposulphite of soda should be pure and free from the traces of sulphur, the plate should be carefully washed with distilled water, both before and after it receives the deposit of copper—in fact, the whole experiment ought to be neatly performed, to prevent what the French significantly call *taches* upon the plate, when the copper comes to be oxidized."

81. *Electro-Silvering the Plate.*—In order to insure a perfectly pure surface of silver, many operators deposit a thin film of silver on the plate by the galvanic battery. This is a good plan, but adds a little to the trouble of the operation; it is well paid for in the superior brilliancy of the proofs obtained from these electro-silvered plates. The apparatus necessary is represented at Fig. 43, where A represents the battery,

Fig. 43.



and B the depositing cell; the battery is to be charged with a mixture of eight parts water, and one part of sulphuric acid; and the depositing cell B is filled with a solution made as follows:—Dissolve two ounces of cyanide of potassium in one pint of water, and then add half an ounce of oxide of silver; as soon as this has dissolved, the liquid is ready for use. A piece of silver foil should be placed in the decomposition cell, and connected by means of a wire with the binding screw attached to the platinized silver of the battery; another wire, with a clip at one end to hold the plate, is attached to the zinc pole of the battery. The plate to be silvered should be carefully cleaned and polished (11), and attached to the small clip, then quickly plunged into the silvering cell opposite to the silver foil; after remaining in for about ten seconds, it will have received

a sufficient thickness of the deposited silver; it should then be taken out and rinsed in a little clean water, rubbed with cotton-wool and a little tripoli, and then polished with the buffs, as described (§ 11), it is then ready for the iodizing process (§ 21).

82. All the different processes necessary to produce a perfect daguerreotype have now been described: upon several points we have dwelt at some length, even at the risk of being tedious; however, as we intended this little work to be a *practical*, and, as far as possible, a *complete* manual of this new and increasingly interesting art, we may, perhaps, be excused if we have insisted and enlarged upon matters which, if not altogether interesting to the practised manipulator, are yet quite important and necessary to be known to a beginner in the art.

THE END.

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